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## FOOD-PLANTS AND DISTRIBUTION OF THE SPECIES OF *CALLIGRAPHA* IN CANADA, WITH DESCRIPTIONS OF NEW SPECIES (COLEOPTERA, CHRYSOMELIDAE) \*

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Twenty-nine species and named subspecies of *Calligrapha* Chev., including eight species previously undescribed, are listed below with notes on food-plants, distribution, and variability. New names are offered for the homonyms *elegans* (Olivier) and *similis* (Rogers). The records and notes, except those credited to authors, are based almost entirely on material in the Canadian National Collection.

Because of the lack of other usable characters, it has been customary to rely largely on color differences for the separation of the species of *Calligrapha*. Although some closely allied species may be separated always by their elytral patterns, there is much variation, both individual and geographic, and the color characters of some species are overlapping and therefore unreliable. Thus, in the species with markings of the types found in *philadelphica* and *scalaris*, the elytra, even those of a single individual, always show some differences in the size, number, or form of the spots. Each species that occurs in Canada from the Atlantic to the Rocky Mountains or to the Pacific forms geographical races, and one species, *philadelphica*, breaks up into numerous races characterized by feeble, inconstant differences in pattern and sometimes in size. Individuals of different species are sometimes so similar that they cannot be identified by color or by other morphological characters.

Experience in the field has shown that the study of food-plants affords an approach to a proper understanding of the species. All species of *Calligrapha* restrict their feeding to one or to a few species of plants. Some of the vittate species feed on, and probably breed on, plants belonging to two or even three closely allied genera. Nearly every species with markings of the types seen in *philadelphica* and *scalaris* restricts its feeding to plants belonging to a single genus, and many species neglect or avoid entirely plants congeneric with their preferred food-plants. The value of such knowledge has been noted by Walsh (27) and by Knab (11), and Knab (11) and Schaeffer (19) have used such knowledge in differentiating species of the genus. As a result of their work, it is possible to identify readily some of the species previously confused, providing one has series of specimens associated with food-plants. The difficulties that remain are concerned largely with the identification of *scalaris* and its closest allies.

In eastern Canada, all the species of *Calligrapha* appear to have similar life histories. The adults hibernate and appear on their food-plants in May. Egg-laying begins in mid May and continues into June. The eggs are usually laid in small clusters on the leaves of the food-plant. The mature larvae enter the soil for pupation, and the first adults of the new generation appear in late July. Emergence continues until mid September, when the beetles seek winter quarters. There is a single generation each year. The beetles occur in isolated colonies which may be diffuse or very restricted, and which may consist of very small or very large numbers of individuals. Populous colonies are subject to

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sudden and drastic reduction by parasites and predators and by disease. Because of this, and because the colonies are probably established by small numbers of individuals, the effective breeding populations are usually small, and the Sewall Wright effect of random changes in small populations should operate. Differences between colonies of *ostryae*, *scalaris*, and *amator*, which appear to be due to this effect, are noted in the following list. Such factors that influence variability are of special interest to the systematist when they concern species which are alike morphologically except for slight, inconstant differences. Parthenogenesis appears to be another such factor in *Calligrapha*. As noted in the table and list below, males are rare or scarce in several species of the *scalaris* complex, and *virginea* appears to be always parthenogenetic. Other species that appear to lack males (with the number of females of each in our collection) are *alnicola* (35), *apicalis* (91), and *rhoda* (29). The elytral pattern is often less variable in such species than in those in which males are abundant.

The species of *Calligrapha* are easily reared in confinement. When given their natural food-plants, the larvae mature with little mortality into adults that appear to be normal in every respect. The author has attempted to rear newly hatched larvae of most species of the *scalaris* complex on the food-plants of other species. The results are given in the following list; some species did and others did not accept the unnatural food-plants, and those of the former class matured on plants that they avoid entirely in nature.

Field studies and the feeding tests have convinced the author that the forms of the *scalaris* complex described below are true species. The forms appear to be isolated reproductively in nature, and they differ physiologically as shown by their feeding abilities and preferences, their sex ratios, and their feeble morphological characters. They possess all the attributes of "ordinary" species except readily appreciated differences in the morphological structures examined. Morphological characters of adults and larvae are compared in the following tables; it will be noted that for each species they are more or less inconstant and overlap more or less those of other species. The tables will permit the ready identification of series of any species but not always of single specimens.

Walsh (27) noted that specimens of *Calligrapha* "*scalaris*" from elm and basswood were always larger than those from dogwood and wild plum. He proposed the term "phytophagic varieties" to designate such forms, in which "certain unimportant characters in the insect are correlated with the food-plant, while at the same time there is no sufficient reason to doubt that the two varieties freely intercross." He designated as "phytophagic species" similar forms which show reproductive isolation, and he considered these as truly distinct as species well characterized morphologically. His forms of "*scalaris*" obviously belong to the second of these categories, rather than to the first as he believed. Thorpe (23, 24, 25) and other recent authors have referred to forms, which are species in every sense except the morphological, as "biological" or "physiological" races. Thorpe has rejected Walsh's idea that phytophagic species are equal in worth to species well characterized morphologically. He defines a species "as a group of individuals distinguished from all other groups by the common possession of certain structural characters", and he states that biological races exist when "the individuals of a species can be divided into groups, occurring in the same locality and showing definite differences in biology, but with structural differences, either very slight and inconstant, or completely absent." He states that he does not wish "to imply that species are morphological entities whereas races are biological", but that "we merely accentuate the morphological characters of species for the sake of convenience in systematic work." Such arbitrary concepts cannot be applied in *Calligrapha* and other genera of Chrysomelidae because breeding populations show every gradation of morphological distinctness. The field naturalist has a precise criterion of species, from every standpoint except

the morphological, in the behavior of his local populations in nature, and he will accordingly discard the morphological concept. Mayer (14) maintains that the reality of a species in nature has nothing to do with its degree of morphological distinctness, and he has offered, as a convenient term, "sibling species" for "sympatric forms which are morphologically very similar or indistinguishable, but which possess specific biological characteristics and are reproductively isolated." Thus *Calligrapha scalaris* and its closest allies, although not always restricted to different food-plants and not always strictly sympatric, are comparable to the phytophagic species of Walsh and to the sibling species of Mayer. They are similar to some of the biological races of Thorpe and to the cryptic species (10) and physiological races of other authors.

Woods (28, 29) segregated species of *Altica* and *Galerucella* in Maine by field studies and by testing the ability of populations from one food-plant to utilize food-plants of other populations. The author (2; 3) has made somewhat similar studies on Canadian species of *Arthrochlamys*, *Calligrapha*, and *Chrysomela*. In the case of each genus, the result has been an arrangement of species different from, and more valid than, any likely to be obtained from the study of morphology alone. The approach is not difficult when one works with local populations of the Chrysomelidae which feed in the larval stage on leaves. Difficulties arise when the populations of different regions are compared, for the poorly characterized species are not always restricted to different food-plants and often differ by morphological characters of the same order as those which distinguish geographical races. Experimental approaches and field studies conducted in intermediate localities may reveal the status of very similar, allopatric forms. Such studies are required, for example, to settle the relationship of *Calligrapha vicina* to *C. philadelphica* and of *C. coreopsivora* to *C. californica*.

LeConte (12) described *scalaris* as greenish blue, and with yellow elytra furnished with greenish blue markings consisting of spots, humeral lunules and a broad, denticulate sutural line. He stated that it occurred from New York to Florida. His figure is obviously crude, for it shows no spots within the humeral lunules. Knab (11) identified *scalaris* as the species which occurs on the elm, *Ulmus americana* L., and on the basswood, *Tilia americana* L. The description and figure suit specimens from these trees. However, four separable forms occur on these trees in Ontario. Authors have recorded "*scalaris*" as occurring on *Tilia* in Ontario (7, 15, 16), Quebec (4, 5), Maine (17), Massachusetts (9), Indiana (1), and Illinois (27), but not, apparently, in the regions which supplied the types of the species. "*Scalaris*" has been recorded on elm in New York (6, 13), Massachusetts (8, 9), Quebec (4, 5), Indiana (1), Nebraska (18), and Kansas (21), and by authors writing in New Jersey (20), and Illinois (27). The final determination of *scalaris* must await critical study of the species of eastern United States, but it is quite possible that the elm-feeder of Ontario, which is listed below as *scalaris*, represents, in part at least, LeConte's species. *Chrysomela scalaris* LeConte, 1824, became a secondary homonym of *Doryphora scalaris* Olivier, 1807, when the latter was transferred to *Chrysomela* by Stal (22), who offered the new name *multiguttis* for LeConte's species. As *scalaris* Olivier has reverted to *Doryphora*, the name *scalaris* LeConte is valid in *Calligrapha*, for according to Townes (26) an opinion permitting the use of such homonyms is to be published shortly by the International Commission on Zoölogical Nomenclature.

*Calligrapha scalaris* Lec., as identified above, and undescribed species with which it has been confused are compared in the tables below and in the following list. The males differ from females in having the apical ventral segment subtruncate, rather than rounded, and in having the apical segment of each maxillary palpus much more broadly triangular. The form of the apex of the male copulatory organ varies intraspecifically in *Calligrapha*, but the organ is of

some value in this group of species as noted in the first couplet below. Because authors have misidentified species of *Calligrapha* and have failed to distinguish between casual and significant occurrence of the beetles on plants, many erroneous records of food-plants are found in the literature. I believe that none of these are perpetuated in the following list.

## ADULTS

1. Food-plant: the hop-hornbeam, *Ostrya virginiana* (Mill.) K. Koch. Elytral epipleura pale reddish brown, except in teneral specimens in which they are white; the elytra usually more heavily maculate than in the other species; the spot within the humeral lunule frequently longer than wide, frequently emarginate anteriorly, joined to the humeral lunule in the more heavily maculate specimens; the subsutural spot of the apical declivity usually broadly joined to the sutural stripe, occasionally small and free; the sutural stripe nearly always gradually narrowed before the apex; the elytral disk of breeding individuals nearly always with rusty suffusions which do not persist in mounted specimens. Head and pronotum usually much more sparsely punctate, the most closely punctate specimens similar to the least closely punctate of the other species. Sides of the abdomen beneath not at all sericeous, the microreticulation scarcely evident. Male copulatory organ with the sides of the median lobe not or scarcely arcuate before the apex, the lobe therefore distinctly wider across the apical processes than before the apex; flagellum distinctly swollen immediately before the apical cleft. Males scarce. Length of males, 6.6 to 8.7 mm.; of females, 7.8 to 9.5 mm. (figs. 18 to 22) ..... 21. *ostryae* n. sp.
- Elytral epipleura largely white, or dark and metallic like the elytral spots; the spot within the humeral lunule not distinctly longer than wide except occasionally in *amator*, not joined to lunule (except on one elytron in one specimen of *amator* and three of *scalaris*), not emarginate anteriorly except rarely in *pruni* and frequently in *ignota*; the subsutural spot of the apical declivity never joined to the sutural stripe by its full length except in some specimens of *ignota* and rarely in *pruni* and *amator*; the elytral disk never with dark suffusions (except possibly in *ignota*). Sides of the abdomen beneath distinctly microreticulate and sericeous except in some specimens of *scalaris*. Male copulatory organ with the sides of the median lobe arcuate before the apex except in *tiliae*, usually strongly so, the lobe therefore about as wide subapically as across the apical processes; the flagellum not swollen before the apical cleft ..... 2.
2. Food-plant: probably the paper birch, *Betula papyrifera* Marsh. Elytral epipleura entirely dark and metallic; the elytral markings extremely variable. The single male measuring 7.8 mm.; length of females, 8.6 to 9 mm. (figs. 1 to 4) ..... 22. *ignota* n. sp.
- Elytral epipleura largely white; the spot within the humeral lunule sub-circular except in some specimens of *amator* and *pruni* ..... 3.
3. Food-plant: American elm, *Ulmus americana* L. Body and elytral markings blue-green. Subsutural spot of the apical declivity of each elytron nearly always joined to the sutural stripe; the latter, except rarely, strongly and abruptly narrowed immediately before the apex; posterior portion of the arcuate band seldom strongly angulate on its hind margin. Males rare. Length of males, 7.4 to 7.6 mm.; of females, 7.8 to 9.3 mm. (figs. 9 to 12, 23) ..... 24. *scalaris* (Lec).
- Food-plant: the basswood, *Tilia americana* L. Body and elytral markings blue-green. Subsutural spot of the apical declivity seldom joined to the sutural stripe, the latter always gradually narrowed before the apex; posterior portion of the arcuate band nearly always strongly angulate on its hind margin. Females only, their length from 8.6 to 10 mm. (figs. 5 to 8, 24) ..... 25. *virginiae* n. sp.

- Food-plant: the basswood, *Tilia americana* L. Body and elytral markings green. Subsutural spot of the apical declivity usually joined to the sutural stripe, the latter always gradually narrowed before the apex; posterior portion of the arcuate band usually strongly angulate on its hind margin. Males rare. Length of the single male, 8 mm.; of females, 8 to 9.2 mm. (figs. 33, 34) ..... 26. *tiliae* n. sp.
- Food-plant: the basswood, *Tilia americana* L. Body and elytral markings blue-green. Subsutural spot of the apical declivity usually free but frequently joined to the sutural stripe, the latter usually gradually, sometimes abruptly, narrowed before the apex; posterior portion of the arcuate band variable, sometimes strongly angled on its hind margin. Males numerous. Length of males, 6.7 to 8 mm.; of females, 7.2 to 9.2 mm. (figs. 13 to 17, 35, 36) ..... 27. *amator* n. sp.
- Food-plant: American plum, *Prunus americana* Marsh. Body and elytral markings green, bluish reflections usually feeble or lacking. Posterior markings of the elytra extremely variable. Body slightly less elongate and averaging much smaller than in any of the other species. Males numerous. Length of males, 6 to 7.1 mm.; of females, 6.7 to 7.7 mm. (figs. 29 to 32) ..... 23. *pruni* n. sp.

## MATURE LARVAE

1. Head capsule largely brown, with anterior and lateral areas and a very narrow median line pale. Labrum and palpi largely brown. Pronotal shield largely brown, the anterior and basal margins narrowly and the median line very narrowly pale, the broadly pale lateral margins enclosing a large brown spot on each side. The transversely lunate, brown spot on each side of the meso- and of the metathorax heavier than in the other species. Coxae, and the sclerites to which they are attached basally, entirely brown on the outer side. Eighth and ninth abdominal tergites each with a large, transverse, brown area. Body smaller. (10 larvae taken from the food-plant at Simcoe and Delhi, Ont.) ..... 23. *pruni* n. sp.
- Head capsule entirely pale except in the ocellar areas. Labrum and palpi entirely pale or feebly infusate. Pronotal shield largely or entirely pale. Coxae and the sclerites to which they are attached largely pale. Eighth and ninth abdominal tergites without dark areas. The dark areas of the pronotal shield, when well developed, consisting of: two small, elongate spots on each side of the very narrowly pale median line, the anterior of these the smaller and frequently broken; a small spot on or near each lateral margin of the shield; a small, submedian, usually broken spot on each side midway between the median and sublateral spots ..... 2.
2. Ten specimens with all spots of the pronotal shield present, the submedian and anterior median in several very small but quite evident. One specimen similar but with the anterior median lacking. One specimen similar but with the submedian spots lacking. (12 specimens reared from eggs taken from the food-plant and from confined females, the eggs and females from Williamsburg, Ont.) ..... 24. *scalaris* (Lec.).
- Twenty-three specimens with the submedian lacking, the other spots present and quite small except in one specimen which lacks the anterior median spots. Three specimens similar but with the submedian spots barely evident. Two specimens similar but with the median spots fused on each side and the submedian spots well developed. (28 specimens reared from eggs of confined females taken at Rockcliffe Park, Ottawa, Ont.) ..... 25. *virginea* n. sp.
- Twenty-two specimens with the pronotal shield immaculate or virtually so. Nine specimens with only very small, posterior median spots. Two speci-

- mens with very small posterior median and very small sublateral spots. (33 specimens reared from the eggs of confined females taken at South Cayuga, Ont.) ..... 26. *tiliae* n. sp.
- Fifty-six specimens with the pronotal shield immaculate or with very indistinct suffusions on areas commonly spotted in other species. Four specimens with all spots present and very small but distinct, except the anterior median which are lacking in three. Two specimens with the posterior median spots very small and all others lacking. (62 specimens reared from eggs and small larvae collected on the food-plant at Almonte, Ont.) ..... 21. *ostryae* n. sp.

## LIST OF SPECIES

1. *Calligrapha lunata lunata* (Fab.).

London, Ont.; probably restricted in Canada to southernmost Ontario. Several authors have reported the occurrence of this species on wild rose in northeastern United States.

2. *Calligrapha lunata hybrida* (Say).

Common on the prairies where it occurs as far north as Rapid City in Manitoba, Cut Knife in Saskatchewan, and Morrin in Alberta. It was found abundant on *Rosa* sp. at Rutland, Sask., by A. R. Brooks and has been reported as feeding on rose in Manitoba by Robertson (1924, 54th Rept. Ent. Soc. Ont. [1923], p. 15). In all specimens from the Prairie Provinces, each elytron bears three discal vittae; *hybrida* is therefore a well characterized subspecies as has been noted by Schaeffer (1934, Jour. N. Y. Ent. Soc., 41:478).

3. *Calligrapha incisa* (Rogers).

Aweme, Man.; recorded from Wawanesa, Man., by Schaeffer (1928, Jour. N. Y. Ent. Soc., 36:291). Food-plant unknown.

4. *Calligrapha bidenticola*, new name (for *Chrysomela similis* Rogers, 1856 [Proc. Acad. Nat. Sci. Philadelphia, 8.35, pl. 1, fig. 13], not Müller, 1776).

Tabusintac, N. B.; Lachine, Wakefield, and Aylmer, Que.; Ottawa, Leamington, and Pt. Pelee, Ont. Feeds on *Bidens frondosa* L. and *B. cernua* L. at Ottawa. This species has been reported as feeding on *Ambrosia* in northeastern United States by several authors, on *Coreopsis lanceolata* L. in Connecticut by Britton (1902, 1st Rept. State Ento. Conn. [1901], p. 276), and on *Bidens frondosa* and *Ambrosia artemisiifolia* L. by Coquillett (1883, Canad. Ent., 15:22).

5. *Calligrapha californica coreopsivora*, new name (for *Chrysomela elegans* Oliver 1807 [Entomologie, V., p. 532, pl. 6, fig. 92], not Gmelin, 1789; = *Zygogramma virgata* Gemminger & Harold, 1874, not Stal, 1859).

From all provinces except Prince Edward Island; feeds on *Bidens frondosa* L. and *B. cernua* L. at Ottawa. The Division of Entomology has received complaints of damage by *coreopsivora* to cultivated *Coreopsis* in Nova Scotia, New Brunswick, Manitoba, Saskatchewan, and British Columbia. It has been taken on *Bidens* in Nova Scotia by A. D. Pickett and has been reported feeding on *Coreopsis lanceolata* L. in Connecticut by Britton (1902, 1st Rept. State Ento. Conn. [1901], p. 275). Several authors have noted *Bidens* and *Ambrosia* as food-plants in northeastern United States.

The type of *californica* was taken in Los Angeles Co., Calif., and was described as having the dark discal vitta of each elytron obliquely divided behind the middle. I have seen twenty-one specimens from southern California, including seven from Los Angeles, and all have the vitta completely divided or virtually so. Their average size is large, the specimens measuring from 6 to 7.2 mm., and they tend to have the dark vittae narrower and the dark area of the pronotum smaller than in eastern specimens. In specimens from Canada and eastern United States, the discal vitta of each elytron is more or less sinuate

on its outer margin but not deeply so except very rarely. Series from southwestern British Columbia differ from eastern series in having the average size slightly greater and the dark markings of the pronotum usually smaller, approaching typical *californica* in these respects. Series from Manitoba, Saskatchewan, and Alberta have the smaller size of eastern specimens and the reduced pronotal markings of those from British Columbia.

6. *Calligrapha praeclis* (Rogers).

Recorded from Bird's Hill, Man., by Gibson (1914, 44th Rept. Ent. Soc. Ont., [1913], p. 117), but this record is probably based on misidentified specimens of *californica coreopsivora*. *C. praeclis* has been recorded as feeding on *Ipomoea pandurata* (L.) G. F. W. Mey. and on *Convolvulus sepium* L. by Hamilton (1888, Canad. Ent., 20:66).

7. *Calligrapha verrucosa* (Suffr.).

The Pas, Man.; many localities in the southern parts of Saskatchewan, Alberta, and British Columbia. Feeds on *Salix*. Some of the published records attributed to *multipunctata* refer properly to this species.

8. *Calligrapha multipunctata multipunctata* (Say).

Lethbridge, Alta.; probably restricted in Canada to southern Alberta. May be expected to occur on *Salix*. The specimens differ from average specimens of *bigbyana* only in having the darker parts, including some of the elytral spots, pale reddish brown.

9. *Calligrapha multipunctata bigbyana* (Kby.).

From all the provinces except Prince Edward Island and Alberta. Feeds commonly on a number of species of *Salix* and rarely on *Populus tremuloides* Michx., although it is very doubtful if larvae occur on the latter in view of the findings of Daviault (1941, Le Nat. Canad., 68:57-81, 89-112) who was unable to rear larvae on *Populus*. *Salix Bebbiana* Sarg. is the preferred food-plant in the Ottawa District and also, according to Daviault, in Quebec. The life history has been studied in Quebec by Daviault and in Nova Scotia by Whitehead (1920, Proc. Ent. Soc. Nova Scotia 5 [1919], pp. 37-40, pl. 2, fig. 5-8). The series from the various provinces show no geographic variation.

10. *Calligrapha philadelphica* L.

New Brunswick to Manitoba; Vernon, Oliver, and Newgate, B. C. Definitely associated with *Cornus* in all these provinces except British Columbia; recorded as feeding on *Cornus* in eastern United States by several authors.

This species shows considerable geographic variation. In series from Montgomery and Delaware Counties, Pa., the humeral lunule is slender and parallel, and external to its basal portion are two small spots; the dark subsutural line terminates just behind the middle of each elytron. Series taken from *Cornus* at Brandon and Riding Mountain Park, Man., and the specimens from British Columbia differ in having the more basal of the external spots larger and joined to the humeral lunule, and the dark subsutural line often prolonged almost to the apex of the elytron. In series from *Cornus* taken on both sides of the Gaspé Peninsula and in northern New Brunswick, the markings are heavier in general; both external spots are joined to the humeral lunule so that the latter is wide in its anterior half; the subsutural line is always prolonged posteriorly. Series from the Ottawa District are intermediate between the more eastern and the western series. Series from the northwestern shore of Lake Erie, taken on *Cornus* by S. D. Hicks and myself, differ from all the others in having the size larger, the length averaging 8 mm., and the spot enclosed by the humeral lunule less variable in form. This spot, extremely variable in the other series, is transversely lunate or, infrequently, divided into two spots in the

Lake Erie specimens. Also, the humeral lunule is not joined to the external spots, although the anterior of these is larger than in the Pennsylvanian series, and the discal spots are heavier and the subsutural stripe is longer than in the Pennsylvanian series.

In all the series mentioned above, the elytral suture tends to be dark at the scutellum. The tendency is very feeble except in those from New Brunswick and Gaspé, and in none of these is the suture dark for more than a short distance behind the scutellum except in some specimens from Cascapedia (Gaspé), Que. In ten of the twenty-six Cascapedia specimens, which were taken on *Cornus*, the scutellar spot is produced posteriorly to or past the middle of the elytra, and in several this sutural stripe joins the subsuturals to produce a broad, common stripe that is streaked with whitish posteriorly. Through the kindness of Dr. Henry Dietrich, I have examined a paratype of *vicina* Schffr. from Olcott, N. Y. In the paratype, the spot partly enclosed by the humeral lunule is transversely lunate on one elytron and divided into two spots on the other. The paratype has a narrow sutural stripe which extends from the scutellum to the middle of the elytra and which is joined to the subsutural stripes by small areas of dark suffusions; otherwise it agrees very well with the Lake Erie series described above. The paratype agrees very well in color with some specimens of the Cascapedia series which, however, are smaller, averaging 6.5 mm. in length. In view of all this, it is possible that *vicina* represents one of the minor races of *philadelphica*. Two specimens unassociated with food-plants, from Rigaud, Que., and Turkey Point (Lake Erie), Ont., agree well with the paratype of *vicina* in every respect.

11. *Calligrapha vicina* Schffr.

See notes on *C. philadelphica* (L.).

12. *Calligrapha alni* Schffr. (= *Chrysomela confinis* Kirby, 1837, not Klug, 1829).

Nova Scotia and Gaspé to Aweme and Norway House, Man.; Waskesiu Lake, Sask.; recorded from Edmonton, Alta., by Carr (1931, 61st Rept. Ent. Soc. Ont. [1930], p. 90). Feeds on *Alnus incana americana* Regel. Our series show no geographic variation. It is quite evident from Kirby's description that this species is his *confinis*.

13. *Calligrapha alnicola* n. sp.

(Figs. 37 to 39)

Females only. Length 7.5 to 8.5 mm. Body broadly oval as in *alni* and *apicalis*. Head, prothorax, and body beneath black, with a feeble green-bronze luster; labrum, palpi, a large spot on each mandible, legs except for the coxae, and the free margins of the apical abdominal segment pale reddish brown. Elytra whitish; more or less suffused with red; with distinctly convex, very dark green markings as follows: on the suture, at least at the scutellum, the stripe so formed usually extending to or beyond the middle of the elytron and usually joining the subsutural stripe which occupies the entire subsutural interval except behind the middle where it is interrupted or narrowed; the subsutural of full width again before the apex, attaining the suture there and gradually narrowed to its tip; arcuate band feebly arcuate, usually entire but occasionally narrowly broken at its middle, joined to the subsutural stripe in about half the specimens; humeral lunule with a wide anterior portion and a narrow, oblique, posterior portion; spot partly enclosed by the lunule transversely lunate or round, occasionally divided into two spots; each elytron with a spot at the middle of the external interval and with thirteen to eighteen small spots, the posterior subsutural of these well separated from the subsutural stripe. Reddish suffusions of the elytra usually distinct, always evident except in teneral specimens; occupying all parts of the sutural and subsutural intervals that are not green and oc-

cupying the interval between the arcuate band and the subsutural stripe when the former is free; the color otherwise restricted to the punctures which are more or less reddish, outlining very narrowly the dark spots but not extending over the areas between the spots. Elytral epipleura largely or entirely reddish yellow, white in teneral specimens.

Pronotum with the sides rather strongly arcuate, but usually less strongly so than in *alni*; the pronotal disk and abdomen less strongly alutaceous and therefore more shining than in *alni*; elytra more sparsely punctate than in *alni*; the sculpture throughout as in *apicalis*. Tarsal claws diverging moderately.

Food-plant: *Alnus incana americana* Regel.

*Holotype* (fig. 37): Norway Bay, Que.; on *Alnus incana americana*; Sept. 6, 1943 (W. J. Brown); No. 5576 in the Canadian National Collection, Ottawa.

*Paratypes*: 24, same locality as holotype, Aug. 27 to Sept. 10, 1942 to 1944; 2, Brome, Que., May 23 and 24, 1936; 2, Arnprior, Ont., June 29 and 21, 1931 and 1942; 5, Blackburn, Ont., June 3 and 12, Aug. 28, 1940 to 1942; 1, Shediac, N. B., July 2, 1939. All paratypes were taken from the food-plant by myself.

The species occurs with *alni*, *confluens*, and *apicalis*. In *alni* the red suffusions are much stronger and more extensive, and the markings are like those of *philadelphica*, the sutural interval never being dark except for a feeble tendency near the scutellum. The pronotum in *alni* usually has a strong brassy cast that is not found in *alnicola*. Specimens of *alnicola* with the red suffusions undeveloped and the arcuate band free can be distinguished from *apicalis* by the bicolored pronotum and the largely white elytral epipleura of the latter. In *confluens*, reddish suffusions are lacking, the size is usually smaller, the elytral epipleura are largely white, and the sutural and subsutural markings are joined together and with the arcuate band to form a heavier dark area. In *vicina*, reddish suffusions are lacking, the punctures of the middle of the pronotum are closer, the sides of the abdomen are strongly alutaceous, and the elytral epipleura are largely white.

14. *Calligrapha apicalis* Notm.

The Ottawa District; Chalk River, Ont.; Parent, Georgeville, and Glen Sutton, Que. Feeds on *Alnus incana americana* Regel. The pale area of each side of the pronotum, at the anterior angle, is about as wide as the labrum, and it extends rather broadly along the lateral margin almost to the posterior angle.

15. *Calligrapha spiraeae* (Say).

Not known from Canada, but the species must occur in southernmost Ontario as it is taken by A. W. Andrews in Oakland County, Mich., on *Physocarpus opulifolius* (L.) Maxim. Cotypes of the species were taken from the same plant according to Say (1826, Jour. Acad. Nat. Sci. Philadelphia, 5:342).

16. *Calligrapha rowena* Knab.

Truro, N. S.; Bathurst, N. B.; Rimouski, Covey Hill, and La Trappe, Que.; Tillsonburg, Simcoe, Southampton, and Hamilton Ont.; recorded from Hamilton, Ont., and Montreal, Que., by Knab (1909, Proc. Ent. Soc. Wash., 11:85). Feeds on *Cornus* and so reported by Chagnon (1938, Le Nat. Canad., 65:14); taken in numbers on *Cornus alternifolia* L. f. at Ithaca, N. Y., by J. G. Franclemont.

17. *Calligrapha knabi* Brown (figs. 25 to 28).

Known only from the type series which was taken at Cascapedia, Que., on *Cornus* sp., probably *C. stolonifera* Michx.

18. *Calligrapha rhoda* Knab.

Walsingham, Ont., feeding on *Corylus americana* Walt. Specimens of the

type series were taken on the same food-plant by Knab (1909, Proc. Ent. Soc. Wash., 11:84). The species is probably restricted in Canada to southernmost Ontario.

19. *Calligrapha confluens* Schffr.

Nova Scotia and Rimouski, Que., to North Bay, Ont., and the Ottawa District. Feeds on *Alnus incana americana* Regel. Some of the cotypes of this species were taken on *Alnus* at Portapique, N. S. The life history has been studied by Whitehead (1919, Proc. Ent. Soc. Nova Scotia 4 [1918], pp. 42-46, pl. 3, fig. 1-4) who has recorded the species as *scalaris* and the food-plant as *Alnus glutinosa*. Schaeffer (1928, Jour. N. Y. Ent. Soc., 36:290) considered *confluens* a variety of *amelia* Knab, the types of which were taken from Staten Island to Virginia on *Alnus rugosa* (Ehrh.) Spreng. However, *confluens* is well characterized and appears to be amply distinct.

20. *Calligrapha dolosa* n. sp.

(Fig. 40)

Length 9 to 9.3 mm. Body elongate as in *scalaris* and its closest allies. Head, prothorax, and body beneath dark blue-green; each anterior angle and lateral margin of the prothorax very narrowly reddish-yellow; this pale margin almost attaining the basal angle, its width above subequal to the width of the third antennal segment, a little greater ventrally; labrum, palpi, a large spot on each mandible, legs except for the coxae, and the free margins of the apical abdominal segment pale reddish brown. Elytra white; the markings green or blue-green, scarcely convex, arranged on each as follows: the sutural and sub-sutural intervals dark; the stripe so formed deeply divided by a white intrusion at the scutellum, not abruptly narrowed before the apex; the arcuate band not entire, its anterior portion slender, oblique, not joined to the sutural stripe in one specimen, its posterior portion transverse, subrectangular, not joined to the sutural stripe; humeral lunule with the oblique posterior portion slender, not joined to the wide anterior portion on one elytron of each paratype; the spot partly enclosed by the lunule rather small, transversely oval or round; each elytron with a spot at the middle of the external interval and with from ten to thirteen other spots, the posterior subsutural of these narrowly joined to the sutural stripe in one specimen but free in the other two; elytral epipleura largely white, each with the internal bead black and the apical third or fourth reddish yellow.

Slides of the pronotum only moderately arcuate as in *scalaris* and its closest allies. The fine punctures of the pronotum scarcely evident, the sculpture of the entire insect otherwise as in *scalaris*; tarsal claws moderately diverging as in *scalaris*.

Food-plant unknown.

*Holotype* (fig. 40): ♀, Metcalfe, Ont., Aug. 22, 1944 (W. J. Brown); No. 5577 in the Canadian National Collection.

*Paratypes*: 1 ♀, Merivale, Ont., June 21, 1943 (W. J. Brown); 1 ♀, Clayton, Ont., Aug. 8, 1941. All localities are situated in the Ottawa District.

The three specimens show little variation. In size, form, and sculpture, this species is similar to *scalaris* and its closest allies. It may be recognized by the narrowly pale pronotal margins and by the form of the arcuate band of each elytron.

21. *Calligrapha ostryae* n. sp.

(Figs. 18 to 22)

This species is well characterized by the sparsely punctate head and pronotum, the heavily maculate elytra, the pale reddish brown elytral epipleura, and by the characters of the male copulatory organ. The body and elytral markings are greenish blue. The color character of the elytral epipleura is often ob-

scured in greasy specimens which may be restored by an overnight soaking in benzol. Teneral specimens, in which the epipleura are white, have been taken in the Ottawa District as early as July 26 and occur commonly during August and September. Figures 18 to 22 all illustrate types of maculation common in the species and show well the range of variation. The more lightly maculate specimens (fig. 22) frequently resemble other species considered in the table but often have the spot within the humeral lunule elongate and emarginate anteriorly.

Food-plant: *Ostrya virginiana* (Mill.) K. Koch.

*Holotype* (fig. 18): ♀, Almonte, Ont., May 28, 1941; No. 5578 in the Canadian National Collection.

*Allotype* (fig. 19): ♂, same data.

*Paratypes*: 12 ♂, 76 ♀, Almonte, Ont., May to September, 1938 to 1942; 6 ♂, 69 ♀, Arnprior, Ont., May to September, 1941 to 1944; 1 ♂, 1 ♀, Kinburn, Ont., Aug. 25, 1940.

All specimens of the type series were taken from the food-plant by myself, and all the localities are situated in the Ottawa District. The average size in the females of the Almonte series is slightly but distinctly greater than in the females from Arnprior. I have seen specimens unassociated with food-plants from Rigaud and Montreal, Que., from Iosco and Oscoda Counties, Mich., and from Mt. MacIntyre, N. Y.

Larvae of *ostryae* may be reared easily on hop-hornbeam, but they will not accept elm or basswood. In the laboratory, fifty-two newly hatched larvae from the Almonte colony were confined on elm and fifty-three on basswood. All died without attempting to feed.

## 22. *Calligrapha ignota* n. sp.

(Figs. 1 to 4)

This species may be known by the elytral epipleura which are dark and metallic even in the extremely teneral paratype from Turkey Point. The body and elytral markings are blue or greenish blue. The maculation of the elytra is more variable than in any other species of the table. The humeral lunule is joined to the anterior portion of the arcuate band in the St. Andrews specimens, and the spot within the lunule may be round or transverse and more or less lunate. The posterior portion of the arcuate band may be obsolete (fig. 4) or well developed and extremely variable. The subsutural spot of the apical declivity may be large and joined by its full length (fig. 1) to the sutural stripe, or it may be small and free. The sutural stripe may be gradually or very abruptly narrowed before the apex.

Food-plant: probably *Betula papyrifera* Marsh.

*Holotype* (fig. 1): ♀, Halifax, N. S., July 1, 1916 (J. Perrin); No. 5579 in the Canadian National Collection.

*Allotype* (fig. 2): ♂, Brackley Beach, P. E. I., July 13, 1941 (J. McDunnough).

*Paratypes*: 1 ♂, Stillwater, N. S., July, 1941; 2 ♀, St. Andrews, N. B., July 11, 1910 (R. C. Treherne); 1 ♀, Turkey Point, Ont., on birch, Aug. 4, 1941 (S. D. Hicks); 2 ♀, Baymouth, Ont., on *Betula papyrifera*, Aug., 1941 (H. S. Fleming).

A specimen of "*scalaris*" with aeneous epipleura from Bethlehem, Pa., has been recorded by Linell (1896, Jour. N. Y. Ent. Soc., 4:198).

## 23. *Calligrapha pruni* n. sp.

(Figs. 29 to 32)

In this species, the body is a little more broadly oval than in the others of the table, and the size is nearly always smaller than in the corresponding sex of the others. The spot within the humeral lunule is more or less rounded or

slightly transverse; in the latter case it is sometimes feebly lunate. The posterior portion of the arcuate band is extremely variable. The subsutural spot of the apical declivity is usually free, but is sometimes narrowly and rarely broadly joined to the sutural stripe. The latter is usually gradually, rarely abruptly, narrowed before the apex.

Food-plant: *Prunus americana* Marsh.

*Holotype* (fig. 29): ♀, Simcoe, Ont., May 28, 1944; (W. J. Brown); No. 5583 in the Canadian National Collection.

*Allotype* (fig. 30): ♂, same data.

*Paratypes*: 38 ♂, 35 ♀, same locality and collector, May 28 and June 26, 1944; 5 ♂, 13 ♀, DeCew Falls (St. Catharines), Ont., collected in July and August or reared from larvae, 1942 (S. D. Hicks); 1 ♂, 3 ♀, Vineland Station, Ont., June 19, 1942 (W. L. Putman); 3 ♂, 3 ♀, Arner, Ont., Aug. 6, 1943 (S. D. Hicks).

All specimens were taken from the food-plant, and all localities are situated in the Lake Erie District. I have been unable to find *pruni* on any of the cherries that grow in proximity to its food-plant.

According to Blatchley (1910, Coleop. Ind., p. 1157), Knab believed that *C. rhoda walshiana* Blatch. might be the form mentioned by Walsh as a variety of *scalaris* occurring on wild plum. Prof. B. Elwood Montgomery has supplied me with photographs of the lectotype and cotype of *walshiana*. These types have the spot within each humeral lunule strongly transverse or divided into two spots, the spot of the external interval of each elytron obsolete or lacking, and the anterior portion of the arcuate band prolonged much more strongly than in most specimens of *pruni*. *C. pruni* and *walshiana* are obviously distinct.

Larvae of *pruni* will accept neither basswood nor elm. Thirty-two newly hatched larvae from the Simcoe colony were confined in the laboratory on basswood, and twelve were confined on elm. Although some larvae of each lot lived a week, all died without attempting to feed.

#### 24. *Calligrapha scalaris* (Lec.)

(Figs. 9 to 12, 23)

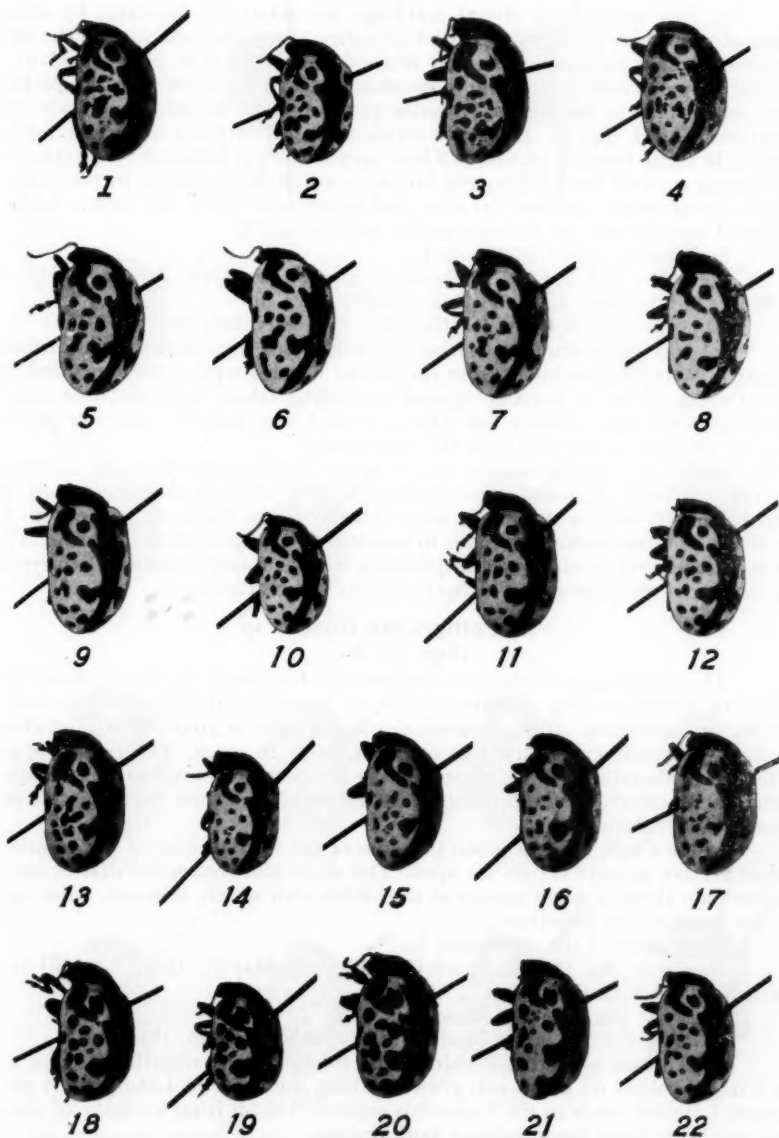
This species is represented in the collection of five females from Norway Bay, Que., and by two males and seventy-seven females from Williamsburg, Ont. All were taken by myself on or in the bark of *Ulmus americana* L. during May and September.

In this species, the posterior markings of the elytra are relatively constant. In seventy-seven of the seventy-nine Williamsburg specimens, the sutural stripe is strongly and abruptly narrowed before the apex (fig. 23). The subsutural spot is joined to the sutural stripe on both elytra of seventy specimens and on one elytron of six. In none is the subsutural spot free when the stripe is gradually narrowed before the apex. Thus all specimens can be separated from all those of *virginea* and nearly all from about half of those of *tiliae* and *amator*.

The Norway Bay specimens of *scalaris* resemble average specimens of the Williamsburg series except that they are rather large, and all have the humeral lunule joined to the arcuate band on one or both elytra. In none of the Williamsburg series are these markings joined.

Although *scalaris* seems to restrict itself to elm, its larvae can feed on basswood. Twenty-six newly hatched larvae from the Williamsburg colony were confined on basswood in the laboratory. Seven died, and nineteen matured into somewhat stunted adults which emerged from their pupal chambers from thirty-six to forty-five days, averaging thirty-eight days, after hatching. As a check twenty-eight newly hatched larvae were confined on American elm. They suffered no mortality; twelve were preserved as mature larvae, and the remaining sixteen emerged full-sized from their pupal chambers from thirty to thirty-six days, averaging thirty-four days, after hatching.

## PLATE IV.



Figs. 1 to 4, *Calligrapha ignota* n. sp. 1, holotype; 2, allotype; 3, 4, paratypes from South Baymouth, Ont.

Figs. 5 to 8, *Calligrapha virginea* n. sp. 5, holotype; 6 to 8, paratypes.

Figs. 9 to 12, *Calligrapha scalaris* (Lec.), from Williamsburg, Ont.

Figs. 13 to 17, *Calligrapha amator* n. sp., paratypes from Point Pelee, Ont.

Figs. 18 to 22, *Calligrapha ostryae* n. sp. 18, holotype; 19, allotype; 20 to 22, paratypes from Almonte, Ont. (Photographs by C. Marier).

25. *Calligrapha virginea* n. sp.  
(Figs. 5 to 8, 24)

In this species the elytral markings are relatively constant. In seventy-three of the ninety specimens of the type series, the subsutural spot of the apical declivity is free on both elytra; in ten specimens the spot is attached to the sutural stripe on one elytron and in seven on both elytra. Several of the specimens resemble *scalaris* in having the posterior portion of the arcuate band only feebly angulate behind (fig. 8). Except in series, adults of *virginea* are scarcely distinguishable from females of *tiliae*. These species differ, however, in average size and in the color of both adults and larvae as noted in the tables, in the behavior of the larvae when confined on elm, and apparently in the sex ratio. Some females of *amator* are not distinguishable from *virginea*.

Food-plant: *Tilia americana* L.

*Holotype* (fig. 5): ♀, Rockcliffe Park, Ottawa, Ont., May 12, 1941; No. 5580 in the Canadian National Collection.

*Paratypes*: 89 ♀, same locality, May to September, 1940 to 1943.

All specimens were taken from the food-plant by myself. I have examined approximately 200 specimens from the colony which supplied the types and have found them all to be females. Several specimens taken from the food-plant at Arnprior, Ont., and Norway Bay, Que., situated forty and fifty miles respectively west of Ottawa, agree well with the type series.

Larvae of *virginea* cannot live on elm or hop-hornbeam. In the laboratory, thirty-eight newly hatched larvae were confined on elm and twelve on hop-hornbeam. All died within eight days. Those on elm made no attempt to feed on that plant, but several were able to moult after engaging in cannibalism. Those on hop-hornbeam produced a few pinholes by attempting to feed. Of thirty-nine larvae reared on basswood as a check, thirty-eight matured.

26. *Calligrapha tiliae* n. sp.  
(Figs. 33, 34)

The markings are relatively constant in this species. In twenty-four of the forty-five specimens, the subsutural spot of the apical declivity is narrowly attached to the sutural stripe on both elytra; the spot is attached on one elytron in fourteen specimens and is free on both elytra in seven. The species is characterized as described in the tables and in the notes on *virginea* but, except in series, it is scarcely distinguishable from *virginea* and from some specimens of *amator* and *scalaris*.

In the single male of *tiliae*, the sides of the median lobe of the copulatory organ are not arcuate before the apex. The organ thus resembles that of *ostryae*, rather than those of other species of the tables with which, however, *tiliae* agrees in the form of the flagellum.

Food-plant: *Tilia americana* L.

*Holotype* (fig. 33): ♀, South Cayuga, Ont., May 27, 1944; No. 5581 in the Canadian National Collection.

*Allotype* (fig. 34): ♂, same data.

*Paratypes*: 43 ♀, same locality, May 27 and June 26, 1944.

All specimens were taken from the food-plant by myself. They occurred as a single colony on basswoods growing along the shore of Lake Erie. A gap of several hundred yards in the basswoods separated them from a colony of *amator*, but neither colony has produced both species.

*C. tiliae* was not found on elms growing among its host trees, but it can feed on elm. Of forty larvae confined on American elm in the laboratory, thirty-seven matured; the adults emerged full-sized from their pupal cells from thirty-five to forty-eight days, averaging forty-one days, after the larvae hatched. Of twenty-two larvae reared on basswood, six died and sixteen emerged from the pupal cells from thirty-six to forty days, averaging thirty-eight days, after hatching.

## PLATE V.

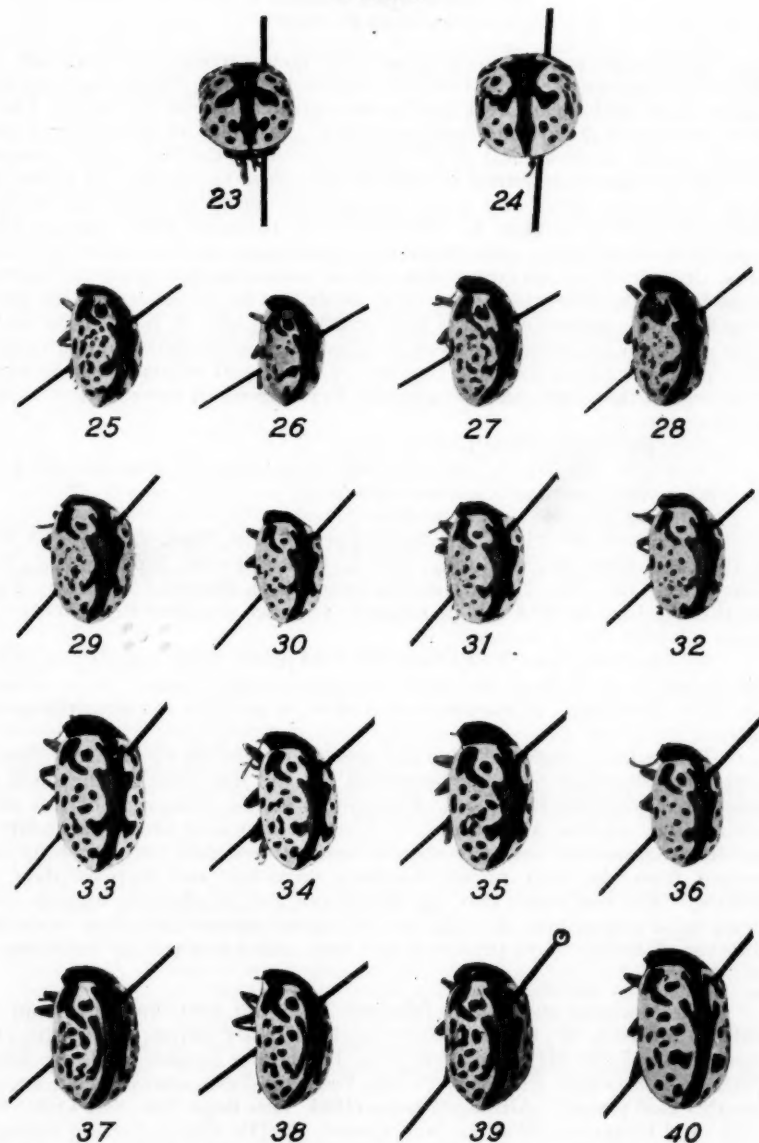


Fig. 23, *Calligrapha scalaris* (Lec.); caudal aspect of specimen shown in fig. 12.

Fig. 24, *Calligrapha virginea* n. sp.; caudal aspect of holotype.

Figs. 25 to 28, *Calligrapha knabi* Brown. 25, holotype; 26 to 28, paratypes.

Figs. 29 to 32, *Calligrapha pruni* n. sp. 29, holotype; 30, allotype; 31, 32, paratypes from Simcoe, Ont.

Figs. 33 and 34, *Calligrapha tiliae* n. sp. 33, holotype; 34, allotype.

Figs. 35 and 36, *Calligrapha amator* n. sp. 35, holotype; 36, allotype.

Figs. 37 to 39, *Calligrapha alnicola* n. sp. 37, holotype; 38, 39, paratypes from Norway Bay, Que.

Fig. 40, *Calligrapha dolosa*, holotype. (Photographs by C. Marier).

27. *Calligrapha amator* n. sp.

(Figs. 13 to 17, 35, 36)

In this species, the markings are extremely variable, and there are some differences between the series from the various localities. The average size in the Turkey Point and Clear Creek specimens is greater than in the others. The posterior portion of the arcuate band, extremely variable in all series, is always broadly joined to the sutural stripe except in some of the Point Pelee specimens, in which it is narrowly joined or entirely free (figs. 14, 15, 17). In a few specimens from Point Pelee and South Cayuga, the small spots on the elytra are greatly reduced in number. In nineteen of the thirty-six South Cayuga and in twenty-four of the thirty-nine Point Pelee specimens, the subsutural spot of the apical declivity is free on both elytra, and the sutural stripe is gradually narrowed before the apex. The others from these localities have the spot free and the stripe abruptly narrowed, or the spot attached on one or both elytra and the stripe gradually or abruptly narrowed. The other series show similar variation. Thus some specimens resemble *virginica* or *tiliae*, and others resemble *scalaris*; one or two of the smallest are very similar to *pruni*. In all series, however, males are numerous.

Food-plant: *Tilia americana* L.

*Holotype* (fig. 35): ♀, South Cayuga, Ont., Sept. 16, 1943 (W. W. Judd); No. 5582 in the Canadian National Collection.

*Allotype* (fig. 36): ♂, same data.

*Paratypes*: 16 ♂, 18 ♀, South Cayuga, Ont., Sept. 6, 1943, Oct. 6 and 10, 1941 and 1939 (W. W. Judd), July 4, 1944 (Mrs. W. Judd); 14 ♂, 25 ♀, Point Pelee, Ont., May 29 and June 8, 1940 (W. J. Brown); 2 ♂, 2 ♀, Turkey Point, Ont., June 2, 1944 (W. J. Brown); 4 ♂, 13 ♀, Clear Creek, Ont., June 13 and 22, 1944 (W. J. Brown).

All specimens were taken from the food-plant; those collected in October were found in the boles of the trees. All localities are situated on the shores of Lake Erie. The species in sympatric with *tiliae*, as noted in the description of the latter.

I have been unable to find this species on elm. At Clear Creek eggs and larvae were abundant on small basswoods but did not occur on the small elms interspersed with the basswoods. Twenty-four larvae from eggs of this colony were confined on elm. All fed freely at first, but they soon became unthrifty and after fifteen days only two were alive. These matured into normal adults which emerged from their pupal chambers thirty-five and forty-six days after hatching. The test shows that the species can live on elm but suggests that it cannot do so successfully. As I did not distinguish *amator* and *tiliae* in the field, no larvae of *amator* were preserved and their characters remain unknown.

28. *Calligrapha pnirsa* Stal.

The Montreal and Ottawa Districts; Hamilton, Ont.; recorded from these localities and from the Quebec District and Rochester, Minn., by Ainslie (1925, *Canad. Ent.*, 57:209-211); recorded from Tippecanoe County, Ind., by Trippel (1934, *Bull. Brooklyn Ent. Soc.*, 29:75). Feeds on *Tilia americana* L.; reported from this food-plant by Ainslie, Gibson (1904, 34th Rept. Ent. Soc. Ont. [1903], p. 52), and Chagnon (1938, *Le Nat. Canad.*, 65:14). Our collection contains a specimen taken at Sunburst, N. C., by O. L. Cartwright. Ainslie states that the species is nocturnal and suggests that it hibernates in its pupal cells. At Ottawa, its behavior and life history are as in the other species of the genus. The adults are active on the food-plant during the hours of daylight. Adults of the new generation appear during mid and late summer and are active well into September. An example of *pnirsa* paired with "*scalaris*" was found at Hamilton, Ont., by Moffat (1885, *Canad. Ent.*, 17:40). On two occasions, the male of *pnirsa* has been found copulating with *virginica* in the Ottawa District.

29. *Calligrapha sigmoidea* (Lec.).

British Columbia; found defoliating *Malva moschata* L. at Fernie by H. B. Leech; found injuring the hollyhock, *Althaea rosea* (L.) Cav., at Edgewood by I. J. Ward. Recorded from Medicine Hat, Alta., by Carr (1929, 59th Rept. Ent. Soc. Ont. [1928], p. 114).

## LITERATURE CITED

1. Blatchley, W. S. Coleoptera or beetles known to occur in Indiana, pp. 1-1386. The Nature Publishing Co., Indianapolis. 1910.
2. Brown, W. J. The Canadian species of *Exema* and *Arthrochlamys*. Canad. Ent., 75:119-131. 1913.
3. .... The dimorphism in the male copulatory organ of the chrysomelid *Arthrochlamys bebbianae* Brown. Canad. Ent., 76:70-72. 1914.
4. Caulfield, F. B. Remarks on *Chrysomela scalaris* Lec., *Chrysomela labyrinthica* Lec., and *Physonota unipuncta* Say. Canad. Ent., 16:226-227. 1884.
5. .... Notes on *Chrysomela scalaris* Lec. Canad. Ent., 17:230. 1885.
6. Fitch, A. Insects infesting deciduous forest trees. Fifth Rept. Noxious and Other Insects of New York, pp. 1-74. 1859.
7. Gibson, A. Basswood, or linden, insects. Thirty-fourth Ann. Rept. Ent. Soc. Ont. (1903), pp. 50-61. 1904.
8. Hagen, H. A. Note on *Chalcographa scalaris* LeConte. Canad. Ent., 16:225-226. 1884.
9. Harris, T. W. A report on the insects of Massachusetts, injurious to vegetation, pp. 1-459. Folsom, Wells and Thurston, Cambridge. 1841.
10. Huxley, J. The new systematics, pp. 1-583. Clarendon Press, Oxford. 1940.
11. Knab, F. Some species of *Calligrapha*. Proc. Ent. Soc. Washington, 11:83-87. 1909.
12. LeConte, J. Descriptions of some new species of North American (coleopterous) insects. Ann. Lyceum Nat. Hist. New York, 1:169-173. 1824.
13. Leng, C. W., and W. T. Davis. List of the Coleoptera of Staten Island, New York. Proc. Staten Island Inst. Arts and Sci., 2:1-90. 1924.
14. Mayer, E. Systematics and the origin of species, pp. 1-334. Columbia University Press, New York. 1942.
15. Morris, F. J. A. Beetles found about foliage. Forty-first Ann. Rept. Ent. Soc. Ont. (1910), pp. 45-51. 1911.
16. .... Chrysomelians of Ontario. Forty-fourth Ann. Rept. Ent. Soc. Ont. (1913), pp. 83-94. 1914.
17. Packard, A. S. Insects injurious to forest and shade trees. Fifth Rept. U. S. Ent. Commission, pp. 1-955. Government Printing Office, Washington.
18. Powell, E. F. The Chrysomelinae of Nebraska. Ent. News, 43:92-97. 1932.
19. Schaeffer, C. The North American species of *Hydrothassa* with notes on other Chrysomelidae and a description of new species and a variety. Jour. New York Ent. Soc., 36:287-291. 1928.
20. Smith, J. B. The insects of New Jersey. Ann. Rept. New Jersey State Mus. (1909), pp. 1-888. 1910.
21. Smith, R. C., and E. G. Kelly. The thirteenth or 1913 annual insect population summary of Kansas. Jour. Kansas Ent. Soc., 17:81-98. 1914.
22. Stål, C. Monographie des chrysomélides de l'Amérique, pt. 3, Actes d. l. Soc. Roy. des Sc. d'Upsal (3), 4:177-365. 1865.
23. Thorpe, W. H. Biological races in insects and allied groups. Biol. Rev., 5:177-212. 1930.
24. .... Biological races in insects and their significance in evolution. Ann. Appl. Biol., 18:406-414. 1931.
25. .... Ecology and the future of systematics. In The new systematics, ed. by J. Huxley, pp. 341-364. Clarendon Press, Oxford. 1940.
26. Townes, jr., H. K. A catalogue and reclassification of the Nearctic Ichneumonidae, pt. 1. Mem. Am. Ent. Soc. no. 11, pp. 1-477. 1944.
27. Walsh, B. D. On phytophagic varieties and phytophagic species. Proc. Ent. Soc. Philadelphia, 3:403-430. 1864.
28. Woods, W. C. The biology of Maine species of *Altica*. Maine Agr. Expt. Sta. Bull. 273. 1918.
29. .... The blueberry leaf-beetle and some of its relatives. Maine Agr. Expt. Sta. Bull. 319. 1924.

A NEW SPECIES OF *GLUTOPS* (DIPTERA, COENOMYIIDAE)

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The genus *Glutops* has been known to contain but one species, the very rare fly *Glutops singularis* Burgess. Probably most of the collection records of *G. singularis* have been published and these number less than a dozen, the records being restricted to the states of New Hampshire, Massachusetts, Connecticut, New York and Pennsylvania. To the published records the writer might add that of a female specimen collected at the Cornell Wild Flower Preserve, Slaterville, New York, on June 1, 1935.

It is of considerable interest, therefore, to encounter a new species of *Glutops* from the opposite side of the continent, represented by specimens from British Columbia and Montana. The first specimens were sent to the writer in a collection of *Symphoromyia*, which they superficially resemble, by Dr. H. H. Ross of the Illinois Natural History Survey. The writer takes pleasure in naming the species for Dr. Ross.

*Glutops rossi* n. sp.

*Female.* Length 6 mm.

*Head.* Antennae black, first two segments with moderately long black hairs; flagellum indistinctly segmented but about five segments may be seen; third segment equal in length to first two segments combined. Front wider than width of eye, gray pollinose and covered with black hairs; ocellar tubercle prominent, ocelli shining black. Face with a bulbous prominence on each side and a smaller swollen area in the center, separated from the lateral swellings by a deep furrow on each side which runs to the base of the antennae; face gray pollinose with black hairs which are longer but finer and less dense than those on the front. Palpi and proboscis black, the latter somewhat reddish brown below; palpi covered with black hair.

*Thorax.* Dorsum dull gray, with an extremely narrow pale gray central stripe and two wider pale gray lateral stripes which enlarge just anterior of the scutellum to form a gray area which includes the scutellum; lateral borders of thorax above wing bases and all the pleura pale gray. Entire thorax with fine black hairs which become quite long at tip of scutellum. Halteres yellow, stem slightly darkened at base. Legs black, gray pollinose; inner side of hind femora with a shining black area; all femora and coxae with black hairs; hind coxae with condyles. Wings with a brownish membrane, with all the veins outlined in dark brown; costal cell dark brown.

*Abdomen.* Brownish gray, dorsally somewhat darker in the center; abdomen covered with black hairs which are quite long laterally and which are very short and fine ventrally.

*Glutops singularis* has been recorded from Agassiz, British Columbia (Ann. Rept. Ent. Soc. Ont., 47th, p. 154, 1916.), but on a basis of geography alone, it is likely that the record should refer to *G. rossi*. The writer attempted to locate the specimen on which this record was based in the Canadian National Collection through the help of Mr. A. R. Brooks, but without success. However, Mr. Brooks did locate a male *Glutops* from another locality in British Columbia. This specimen could easily be the hypothetical male of *G. rossi* and it has been designated the allotype in the belief that the sexes are correctly associated.

*Male.* Length 7 mm.

*Head.* Antennae black, extreme base of hind segment reddish brown; first two segments with very long black hair which is especially long dorsally; tip of flagellum indistinctly segmented but five or six segments are present; third segment of antennae somewhat longer than first two segments combined. Eyes

broadly contiguous; ocellar tubercle prominent, ocelli yellowish brown. Occiput with long black hairs which curve forward over the upper margins of the eyes. Face dull bluish gray pollinose, with a large lateral bulbous prominence on each side which is much larger than in the female; a smaller swollen area in the center is separated from the lateral swellings by a deep furrow on each side; these furrows meet some distance below the antennae forming a deep squarish depression. Face completely covered with very long black hair. Palpi and proboscis black, the former covered with long black hair.

*Thorax.* Dorsum velvety black, with two very narrow gray lines which extend two-thirds the length of the thorax and a small gray area just above and anterior of the wing bases; scutellum velvety black, somewhat paler at the tip; pleura gray pollinose; thorax with long black hairs with a reddish tinge which are especially long at the tip of the scutellum. Halteres yellow. Legs dark brown, coxae and femora gray pollinose, with black hair which is quite long and dense on the coxae; inner side of femora shining; hind coxae with small condyles. Wing membrane brownish, darker in costal area.

*Abdomen.* Velvety black; the third tergite is gray laterally for the width of the segment and this marking gradually narrows toward the center of the segment leaving a large black triangular area with its base along the apex of the segment; the fourth and fifth segments are similar to the third but the black is reduced to a small triangle on the fourth segment and to a small spot on the fifth. The venter is uniformly gray. The entire abdomen is covered with black hairs that are quite long laterally.

*Type data.* *Holotype*, female, Port Haney, B. C., July 6, 1940 (H. H. and J. A. Ross); in the collection of the Illinois Natural History Survey, Urbana, Illinois. *Allotype*, male, Lillooet, B. C., July 23, 1917 (J. D. Tothill), 1500 ft.; in the Canadian National Collection, Ottawa, Ontario. *Paratypes*, two females, west side Glacier National Park, Montana, July 11, 1940 (H. H. and J. A. Ross); one paratype in the collection of the Illinois Natural History Survey and one in the writer's collection.

*Comparative notes.* *Glutops rossi* is similar to *G. singularis*, the only known species in the genus, but in general it is a much darker insect. Both sexes of *G. rossi* may be recognized by the dark legs, antennae and palpi, darker wing membrane, pale halteres and different thoracic pattern; the female may further be distinguished by the third antennal segment which is proportionately shorter than in *G. singularis*; in the male, the velvety black of the thorax and abdomen is quite characteristic.

## A LABORATORY METHOD FOR DETERMINING THE MINIMUM ACTIVE TEMPERATURES OF INSECTS

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It is often important to the successful conclusion of insect field-studies to know the air temperatures which govern insect activities, particularly the minimum temperature at which flight occurs. In the field, this is usually a matter of continued observations on the relative abundance of a species, correlated to some degree with observations on the air temperatures at the times of abundance or of flight. This method is apt to produce a collection of temperature ranges rather than exact temperatures. Accordingly, the writer offers a method recently employed in certain laboratory experiments, in the hope that it may prove useful to other workers.

In its simplest form, this method requires at least two mercury air temperature thermometers and some form of cold chamber. The actual refrigeration process of the chamber is not important. However, it is essential that the

chamber be of such a design that it can be opened to the outside air without warming the interior too rapidly. To satisfy this requirement, the chamber must be equipped with a lid at the top, not with a door at the side.

The apparatus available to the writer was essentially of this design. The air within the chamber was fan-circulated during cooling. When the desired low temperature was reached, the fan was shut off and the top of the chamber opened. Stopping the fan allowed the air in the chamber to layer according to its temperature, with the coldest air at the bottom. Opening the top had the two-fold advantage of permitting manipulation of thermometers and specimens, and also of permitting the air temperature to rise slowly, while still layered.

In practice, the ice-point readings of two mercury thermometers were checked, so that any discrepancy might be corrected at the beginning of the work. The thermometers were then suspended within the cold chamber with the bulbs about one-half inch apart. This gave the air temperature of a given layer at two points within one-half inch. (It is essential that both bulbs be exactly the same height above the floor of the chamber, since the air is layered horizontally as to temperature.) The thermometers were shielded from serious radiation effects with corrugated cardboard placed on the floor and against the nearest wall.

With the thermometers in place, the chamber was cooled to the desired temperature (usually about  $-5.0^{\circ}\text{C.}$ ). Then the refrigeration and the air circulation were stopped, the top opened, and an active insect dropped into the chamber. Within a few seconds, the insect was inactivated, and it was possible to attach a fine hair to its body with a drop of gum arabic. The inert insect was then lifted upon the hair until it was suspended between the bulbs of the two thermometers.

Under the above conditions, with the top open, the cold chamber used by the writer warmed at the rate of about one degree Centigrade every four minutes. This rate is ideal, since it is not so slow that it tries the patience of the operator, yet it is slow enough that there is no appreciable lag in the thermometers, or in the rate of recovery of most insects from lower temperatures. It also provides ample time for note-taking.

To conclude a given experiment, it is only necessary to observe the return to activity in the specimens as the temperature rises. It is sometimes necessary to prod the insect occasionally to determine the extent of its activity. This method of observation gives a very complete picture of the returning activity correlated with temperature change.

Thus, it is possible to determine the temperatures at which antennal, leg and wing movements first occur. A strip of paper at the environmental temperature, introduced under the insect, will aid observations upon the increasing ability to crawl. The minimum flight temperature-range must be subdivided into the temperature at which an insect attempts to fly, if teased, and the temperature at which it flies with some facility. Such temperatures must not be confused with optimum flight temperature-ranges as determined in the field. However, they serve as valuable additional data to such field observations.

The writer has omitted any discussion of the use of thermo-couples, since this method is designed primarily for the laboratory worker who must utilize extremely makeshift equipment. Any worker addicted to the use of the thermo-couple will no doubt find it a simple matter to modify the above method for its most effective use.

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